

EFFECTS OF WATERSHED MANAGEMENT PRACTICES ON THE FISH COMMUNITY
AT SKINNER LAKE

COMPLETION REPORT

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Abstract

Following application of soil conservation practices, primarily minimum tillage and terracing, in a 10,000 acre northeast Indiana watershed, there were no major shifts in species composition and relative abundance of fish in Skinner Lake, a 125 acre eutrophic natural lake. Notable changes associated with a 36% decrease in total phosphorus loading and a savings of 17,015 tons of soil annually included a 70% decrease in mean gill net catch rates of white crappies, increases in growth of age 3 and 4 black crappies and increases in percentages of larger black and white crappies. Since the watershed project, strong year classes of crappies have not developed. There were no statistically significant changes in catch rates of bluegills, largemouth bass or white suckers, as well as no significant changes in bluegill and bass sizes, weights, or growth.

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EFFECTS OF WATERSHED IMPROVEMENT PRACTICES ON THE FISH COMMUNITY AT SKINNER LAKE

For over 25 years, Skinner Lake has been plagued with several fish management problems: turbidity, sedimentation, water level fluctuations, nutrient inputs, algal blooms, excessive plant growth, abundant rough fish, and poor quality sport fishing. These problems have been associated with accelerated eutrophication due to agricultural development in the watershed.

In 1977, the Environmental Protection Agency under the Clean Lakes Program and the Department of Agriculture funded various soil and water conservation practices in the Skinner Lake watershed. These practices included minimum tillage, terracing, construction of sediment basins, tiling, and reconstruction of tributaries. They were designed to control soil erosion and to reduce nutrient runoff and sediment transport to Skinner Lake. Most of the work was completed by 1980.

From 1978 through 1980, the Fisheries Section of the Indiana Department of Natural Resources conducted annual fish population surveys to obtain preliminary information on the fish community at Skinner Lake. Followup surveys were conducted from 1984 through 1986 to evaluate any changes in the fish community resulting from the watershed improvement project.

The final results are presented in this report.

PROJECT SITE

Skinner Lake is a 125 acre natural lake located 3 miles east of Albion in Noble County, Indiana (Figure 1). Maximum depth is 32 feet and average depth is 14 feet. The lake's large watershed (9,977 acres) consists of rolling hills, characterized by agricultural row crops and some scattered woodlots. The lake's shoreline is surrounded by permanent residences and little natural shoreline remains. Public access is available at a state-owned site, constructed in 1984 at the southwest corner of the lake.

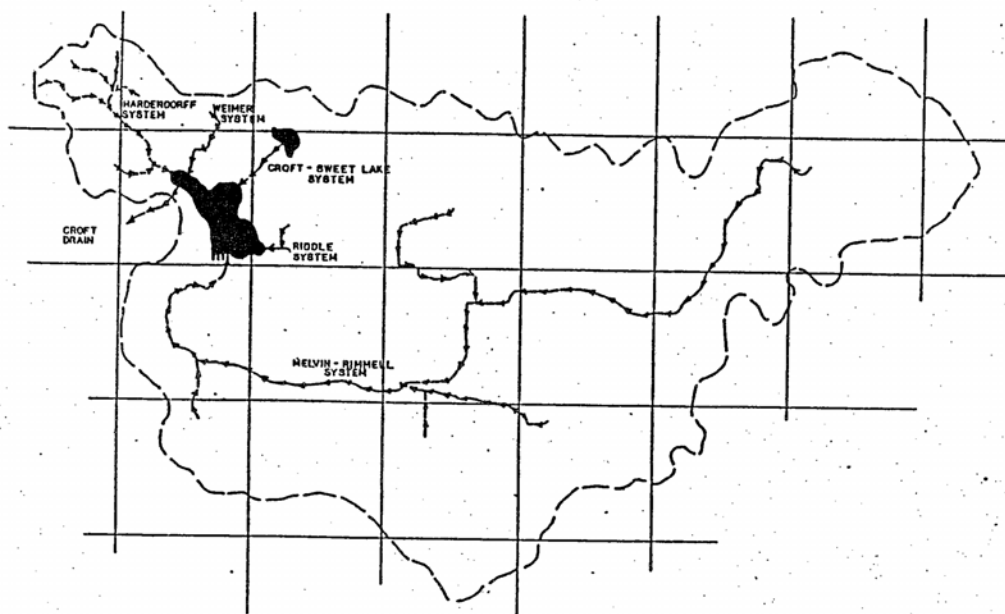
Skinner Lake lies in the Elkhart River watershed within the Lake Michigan Basin. Immediately northeast of Skinner Lake ($\frac{1}{2}$ mile) is Sweet Lake, a 20 acre natural lake that drains into Skinner. The principal inlet to Skinner Lake is the Rimmel Drain. It rises about 5 miles east of the lake and drains half of the lake's watershed and provides 79% of the water discharged to the lake. Three other small ditches also empty into the lake. The lake has an average flushing rate of $2\frac{1}{2}$ - $5\frac{1}{2}$ times per year, most of which occurs during spring snow melt and runoff.

Originally, much of the area south and east of Skinner Lake along the Rimmel Drain was wetland. This area and several smaller areas were drained for farming. The original lake level was lowered 5 feet in 1883. A concrete sill dam was constructed on the outlet, Croft Ditch, in 1962. It was replaced in 1984 with a sheet metal dam following wash-out of the concrete dam during spring 1982.

Skinner Lake thermally stratifies between 8 and 16 feet with water temperatures dropping from the low 70°F to low 60°F. Summer surface temperatures occasionally exceed 80°F. Dissolved oxygen concentrations drop to levels insufficient for fish between 10 and 15 feet (<3 ppm). Light penetration, based on secchi disc readings, is restricted to the top 7 feet of water because of suspended organic and inorganic materials.

Figure 1. Skinner Lake watershed and depth contours.

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At times, secchi disc readings are less than 3 feet. Early July secchi disc readings averaged 4½ feet from 1978-1980 and 6 feet from 1984-1986.

Coontail and water milfoil are the dominant types of submergent plants. Spatterdock is the major emergent plant. Coontail and milfoil reach the surface and surround the lake from the shoreline to a depth of 6 feet but grow as deep as 12 feet. Periodic green and blue-green algae blooms occur at Skinner Lake, usually in spring and late summer. Blooms are so dense at times that the water develops a "pea-soup" color. The lake bottom is primarily muck with areas of silt, sand, and marl.

WATERSHED IMPROVEMENT PRACTICES

The Skinner Lake watershed project was designed as a model land treatment program to restore water quality in Skinner Lake through a variety of soil conservation practices. Total cost of the project was \$1,006,501 and was administered by the Noble County Soil and Water Conservation District (NCSWCD, 1982).

Cost incentives were offered to landowners for 1,276 acres of minimum tillage (22% of possible), 43,405 feet of terraces (86% of possible), 4,686 feet of tile (9% of possible), vegetative cover on 519 acres, three animal waste systems, livestock exclusion, structural diversions, grade stabilization, and construction of three small sediment basins. Cost of these practices affecting 2,800 acres was \$312,552, of which 79% was spent on terraces. Terraces, minimum tillage, and vegetative cover proved most effective at controlling soil loss, saving 16,107 tons of soil out of 17,015 tons saved annually by all practices. Terraces saved 5,941 tons and minimum tillage saved 7,141 tons of soil annually.

The project included reconstruction of the Rimmel Drain and removal of a silt delta in the lake (\$72,000), construction of a 5 acre detention and settling basin on the Rimmel Drain about 800 feet from the lake (\$40,000)

and channel reconstruction, tiling, and a sediment basin on the Hardendorff Drain (\$53,000). Because of improper initial construction and damage done by a 100-year frequency flood, the Rimmel Drain was rebuilt at a cost of \$137,000. Other than chemical spot treatment of aquatic vegetation by lake residents, no direct lake treatment practices were initiated.

Based on estimates provided by Michigan State University personnel (McNabb et al, 1982), inlet discharges during spring provided less total nitrogen loading (51%) and less phosphorus loading (36%) after the land management practices (1982) than before (1979). Although the Rimmel Drain basin reduced sediment loading to the lake by 14% and reduced phosphorus loading by 8%, overall suspended particulate matter entering the lake was not reduced. The net result of the project was an improvement in the trophic state of the lake, based on a lake eutrophication model, due to reduced phosphorus loading.

FISH SAMPLING METHODS

To determine the effects of the watershed project on the fish community at Skinner Lake, fish population surveys were conducted in early July from 1978-1980 and 1984-1986. Effort consisted of 1 hour of nighttime electro-fishing along the entire shore each year with some additional daytime electro-fishing in 1978 and 1980. Electrofishing gear consisted of a boat-mounted generator (230 volts AC) and three electrodes suspended from the bow. Two men plus the boat operator dipped-up stunned fish.

Gill net and trap nets were also used to collect fish. Gill net and trap net effort varied from six overnight sets to nine overnight sets. Gill nets were composed of five 50 foot long panels of multifilament nylon netting (1½-5 inch stretch mesh) totaling 250 feet long and 6 feet deep. Trap nets consisted of a 3 x 5 foot metal frame with a series of attached hoops and netting (1-2 inch stretch mesh) with leads of 25-200 feet. During each survey, gill nets and trap nets were generally fished at the same locations.

Catches per gear were recorded separately so changes in fish abundance based on catch per effort could be examined.

Each captured fish was identified, measured, and weighed. Scale samples were taken for age and growth determinations for major game fish (direct proportion method using a 0.8 inch body-scale relationship intercept). Scales were normally taken from the first five fish randomly collected per $\frac{1}{2}$ inch over their entire length range and additional scales were taken, if possible, to obtain at least one scale sample per tenth-inch. Once processed, unharmed game fish were returned to the lake.

SURVEY CATCHES

Species Composition

After the watershed project, the average number of fish collected in annual surveys declined 41%, due in part to less sampling effort but also due to notable decreases in catches of black and white crappies, yellow perch, and pumpkinseed sunfish (Table 1). Smaller decreases were noted in catches of bluegills and largemouth bass, as well as white suckers and golden shiners.

Despite decreases in catches, there were no major shifts in relative abundance of various species in the fish community. After 1978, bluegills ranked first in the catch and comprised 49% or more of the catch. They averaged 55% of the 1979 and 1980 catches and 63% of the 1984-1986 catches. Black crappies decreased from 16% of the pre-project catch to 8% of the post-project catch, yet remained second overall. Excluding the 1978 catch, the percentage of black crappies before the project was identical to the percentage after the project (8%). All other species comprised less than 10% of the catches before and after the watershed project and their rank stayed about the same. Largemouth bass made up 2-4% of the catch each year while the average percentage of white suckers stayed the same (6 $\frac{1}{2}$ %).

Table 1. Number of fish collected in surveys* at Skinner Lake, 1978-1980 and 1984-1986.

Species	1978	1979	1980	Pre-project Average	1984	1985	1986	Post-project Average
<u>GAME FISH</u>								
Bluegill	389	784	635	603	462	663	337	487
Black crappie	397	99	107	200	46	66	78	63
White crappie	128	54	104	95	26	20	34	27
Other sunfish	52	110	116	93	10	32	44	29
Yellow perch	75	46	65	62	16	17	45	26
Largemouth bass	23	38	40	34	26	29	18	24
Bullheads	11	14	20	15	8	12	20	13
Northern pike	2	3	3	3	0	1	0	1
Channel catfish	0	0	0	0	1	0	0	1
<u>NONGAME FISH</u>								
White sucker	88	88	96	83	59	50	67	49
Gar	18	11	8	12	11	11	10	11
Carp	14	5	7	9	2	2	4	3
Others	84	79	39	67	11	9	26	15
<u>TOTAL</u>	1,281	1,331	1,240	1,284	678	912	683	758

* Sampling effort:

July 3-6, 1978: 1-3/4 hrs electrofishing, 9 gill net lifts, 6 trap net lifts.

July 3-5, 1979: 1 hr electrofishing, 8 gill net lifts, 8 trap net lifts.

June 30-July 3, 1980: 2 hrs. electrofishing, 7 gill net lifts, 9 trap net lifts.

July 9-11, 1984: 1 hr electrofishing, 8 gill net lifts, 8 trap net lifts.

July 1-3, 1985: 1 hr electrofishing, 6 gill net lifts, 8 trap net lifts.

June 30-July 2, 1986: 1 hr. electrofishing, 6 gill net lifts, 8 trap net lifts.

The pounds of fish collected after the project decreased 39%, reflecting the decrease in numbers (Table 2). The major decreases were among black and white crappies, perch and sunfish, the same fish which exhibited the largest decreases by number. By weight, black crappies were important (>10%) in the 1978 catch. By 1979, as the project got underway, they had already declined to only 7½% of the weight. Excluding 1978, black crappies made up 6% of the weight before the project and 6½% after the project. White crappies averaged only 6% of the survey catch by weight before the project but decreased to 3% after the project. However, the percentage of white crappie poundage in 1986 (5½%) was identical to the percentage in 1978 (5½%). By weight, the percentages of perch or sunfish never reached 3%.

Before the watershed project, bluegills comprised 12-30% of the weight in annual surveys and averaged 19%. After the project, the percentages stayed about the same, varying from 13-33% and averaging 24%. Bass averaged 5½% of the weight before the project and 6½% after. Northern pike, although never important in the catch numerically or by weight, were even less important after the watershed project. Populations of bullheads, gar, carp, and other nongame fish were unimportant in the survey catches before and after the project. White suckers, however, comprised 25% of the weight before the watershed project and about the same percentage (28%) after the project.

Based on the number and weight of fish collected in the annual surveys, the watershed management program did not produce any major shifts in the overall species composition of the fish community at Skinner Lake.

Catch per Effort

In lieu of estimates of population size, comparing numbers of fish collected by each type of sampling gear for equal amounts of sampling time (catch per effort) provides information on whether there were any significant changes in actual numbers of major fish in the lake before and after

Table 2. Pounds of fish collected in surveys at Skinner Lake, 1978-1980 and 1984-1986.

Species	1978	1979	1980	Pre-project Average	1984	1985	1986	Post-project Average
<u>GAME FISH</u>								
Bluegill	41.2	91.7	53.5	62.1	58.6	73.3	22.8	51.6
Black crappie	60.1	22.7	16.4	33.1	11.8	13.7	15.0	13.5
White crappie	19.3	10.3	29.4	19.7	5.7	4.1	10.1	6.6
Other sunfish	3.3	8.2	7.8	6.4	1.7	2.3	2.2	2.1
Yellow perch	7.8	5.7	8.9	7.5	1.8	1.9	4.7	2.8
Largemouth bass	15.1	20.2	18.5	17.9	10.4	18.4	10.7	13.2
Bullheads	6.9	9.3	11.3	9.2	3.5	8.6	11.2	7.8
Northern pike	10.7	12.0	16.5	13.1	-	4.0	-	1.3
Channel catfish	-	-	-		1.8	-	-	0.6
<u>NONGAME FISH</u>								
White sucker	80.3	73.3	97.4	83.7	63.3	48.6	56.8	56.2
Gar	40.9	21.7	15.9	26.2	28.0	26.7	19.0	24.6
Carp	56.3	14.0	37.0	35.8	13.8	13.5	19.3	15.5
Others	13.9	14.6	26.1	18.2	2.5	10.5	10.4	7.8
TOTAL	355.8	303.7	338.7	332.7	202.9	225.6	182.1	203.5

the watershed project (Table 3).

The average number of bluegills captured by electrofishing after the project (219/hour) was 44% higher than before the project. But, the gill net catch rate declined 13% and the trap net catch rate declined 36% after the project. The average number of bass collected after the project (20/hour) by electrofishing was 13% less than before the project. None of the differences in average bluegill and bass catch rates, however, were statistically significant ($t < 1.31$). White sucker catch rates were also not significantly different after the watershed project.

As mentioned earlier, there were notable decreases in catches of black and white crappies but they may not have been directly related to the watershed project. Crappies were primarily caught in gill nets. From 1978-1979 in the initial stages of the project, gill net catch rates of black and white crappies decreased 79% and 58%, respectively. The average black crappie catch rate in 1979 and 1980 (11/net) was identical to the average catch rate in 1985 and 1986. The number of black crappies captured by electrofishing was high in 1978 and 1979 (> 23 /hour) but dropped sharply by 1980 (3/hour) and was similar to the average catch rate after the project (5/hour). The average number of white crappies captured by electrofishing before the project (3/hour) was similar after the project (2/hour). Although, the white crappie gill net catch rate decreased from 1978-1979, the catch rate increased in 1980 (14/net). Perhaps the 70% decline in the average white crappie gill net catch rate from 1978-1980 (10/net) to 1984-1986 (3/net) may have reflected the most significant change ($t = 2.55$) in fish abundance associated with the watershed improvement project.

Despite decreased catches of crappies, Skinner Lake continues to support a high number of crappies, compared to other lakes in the area. Black crappies are considered abundant when they comprise at least 10% of survey catches by

Table 3. Catch rates* of major fish collected at Skinner Lake, 1978-1980 and 1984-1986.

	1978	1979	1980	Pre-project Average	1984	1985	1986	Post-project Average
Bluegill								
N/EF	68	239	148	152	159	269	228	219
N/GN	54	67	59	60	61	50	46	52
N/TN	34	60	31	42	30	43	8	27
Black crappie								
N/EF	26	23	3	17	9	2	3	5
N/GN	33	7	14	18	2	10	11	8
N/TN	9	2	1	4	2	1	1	1
White crappie								
N/EF	4	4	2	3	1	2	3	2
N/GN	12	5	14	10	3	4	3	3
N/TN	2	2	1	2	1	1	2	1
Largemouth bass								
N/EF	11	37	20	23	22	23	15	20
White sucker								
N/EF	14	35	14	21	16	20	20	19
N/GN	7	6	10	8	4	4	8	5

N/EF = number of fish collected per hour of electrofishing.

N/GN = number of fish collected per gill net.

N/TN = number of fish collected per trap net.

number and 5% by weight and provide gill net catch rates exceeding four crappies per net (Pearson 1984). White crappies are seldom found in north-east Indiana lakes but where they are present, they are considered abundant when they make up percentages in survey catches similar to black crappies and provide a similar gill net catch rate. In the latest survey, black crappies comprised 11½% of the catch by number, 8% by weight, and a gill net catch rate of 11 crappies per net. White crappies made up 5% of the catch by number, 5½% by weight, and provided a gill net catch rate of three crappies per net.

Fish Size

Bluegill, crappie, and bass populations in Skinner Lake have been dominated by intermediate-size fish with few fish large enough to interest fishermen. Between 1978-1980, bluegill proportional stock density (PSD) varied from 28-56 and averaged 39 (Table 4). This means 39% of all stock-size bluegills (≥ 3 inches) were 6 inches or larger, while 61% were 3-5½ inches long. Bluegill PSD after the project did not change (39). Relative stock density (RSD) of preferred bluegills (≥ 8 inches) was zero in all years except 1979. This means 8 inch or larger bluegills were found only in 1979. In balanced fish communities, bluegill PSDs vary from 20-40 and RSDs vary from 5-10. Therefore, Skinner Lake contained sufficient percentages of 6-7 inch bluegills, in fact too many in 1979 and 1984, but never contained enough larger bluegills.

Black and white crappie PSDs and RSDs increased considerably after the watershed project, reflecting a shift toward larger sizes. This means the percentages of 8 inch and larger crappies (PSD) and 10 inch and larger crappies (RSD) increased, while percentages of 5-7½ inch crappies decreased. The increases in black crappie PSD and white crappie RSD were significant ($t > 2.84$). Optimum crappie PSDs are 30-60 and optimum RSDs are 10-20.

Table 4. Proportional and Relative Stock Densities* of major game fish collected at Skinner Lake, 1978-1980 and 1984-1986.

	1978	1979	1980	Pre-project Average	1984	1985	1986	Post-project Average
Bluegill								
PSD	34	56	28	39	57	39	20	39
RSD	0	1	0	1	0	0	0	0
Stock N	381	726	630	579	452	648	311	470
Black crappie								
PSD	6	4	18	9	51	33	23	36
RSD	0	4	1	2	9	5	3	6
Stock N	395	95	107	199	45	63	78	62
White crappie								
PSD	5	59	11	25	52	53	91	65
RSD	0	0	3	1	8	5	9	7
Stock N	128	51	100	93	25	19	34	26
Largemouth bass								
PSD	33	46	53	44	10	23	44	26
RSD	19	8	13	13	0	12	0	4
Stock N	21	24	15	20	21	26	16	21

* bluegill minimum size (inches) : stock = 3, quality = 6, preferred = 8

crappie minimum size (inches) : stock = 5, quality = 8, preferred = 10

bass minimum size (inches) : stock = 8, quality = 12, preferred = 15

Not once did crappie RSDs reach 10%. Black crappie PSDs were below normal 60% of the time and white crappie PSDs were outside the optimum range 50% of the time. They varied from a low of 5 in 1978 to a high of 91 in 1986.

Largemouth bass PSDs and RSDs were generally higher before the watershed project than after. This means the bass population shifted toward smaller fish. However, the differences were not statistically significant ($t < 1.83$), mainly because bass PSDs after the project varied so much (10-44), as did bass RSDs (0-12). Ideally, bass PSDs should be 40-60 in balanced fish communities and 20-40 where considerable predation of bass is needed to control prey fish populations. Optimum RSDs are 10-20.

Fish Weight

Except for decreases in weights of larger bass, there were no changes in the average weight of fish before and after the watershed treatment project (Table 5). Mean weights per length often increase when numbers of fish decline and weights decrease when numbers of fish increase. There is no evidence to suggest the decreases in bass weights were related to any increases in bass numbers. On the other hand, despite apparent decreases in numbers of crappies, accompanied by increases in crappie lengths, there were no increases in crappie weights.

Age Composition

Bluegills, black and white crappies, and largemouth bass underwent sizeable variations in year class strength at Skinner Lake, based on relative abundance of younger age-groups in survey catches each year. Stronger year classes were produced in 1975 and 1978. Weaker year classes were produced in 1976 and 1977. Although these patterns were similar among all four species, year class variations were more pronounced among crappies.

Age 3 crappies overwhelmingly dominated the black and white crappie populations in 1978. As a result of poor recruitment in 1976 and 1977, crappie numbers decreased, corresponding to the decline in 1979 crappie catches. The slight increases in crappie catches in 1980 were due to the appearance of the stronger 1978 year classes (age 2).

Since the watershed project, crappie recruitment has been lower and variations in year class strength have been less pronounced. Age 2 black crappies comprised similar percentages (44-49%) of the catch each year from 1984-1986, unlike 1978-1980 when they made up 0-59%. Age 3 black crappies also comprised more stable percentages (28-40%) after the project, as did age 3 white crappies (43-57%).

After the watershed project, strong year classes of bluegills and bass were produced in 1982. They dominated the 1984 and 1985 survey catches. Relatively strong bluegill and bass year classes were also produced in 1983 and made up substantial percentages of the 1985 and 1986 catches, even though they didn't contribute much to the 1984 catch. Bass recruitment in 1984 and 1985 appeared to be low while bluegill recruitment was more constant.

Fish Growth

The most notable changes in fish growth after the watershed project included a decrease in bluegill growth and an increase in crappie growth (Table 7). Growth of bass stayed about the same. On the average, back-calculated lengths at time of annulus formation declined 7% among all age-groups of bluegills and improved 9% and 14% for black and white crappies. White crappies were the only fish to show a consistent increase in mean lengths at time of capture after the project (14%).

Although bluegill growth generally declined and crappie growth increased, few of the differences were statistically significant. Among bluegills, only the decrease in back-calculated length of age 4 fish was

Table 6. Relative abundance of various age groups of major game fish at Skinner Lake, 1978-1980 and 1984-1986.

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Number and Percent of Scale Samples per Year								
	1978	1979	1980	Pre-project Average	1984	1985	1986	Post-project Average
BLUEGILL								
Age 1	8 (15%)	20 (29%)*	4 (7%)	11 (18%)	10 (15%)	12 (19%)	10 (18%)	11 (17%)
Age 2	14 (26%)	16 (24%)	29 (49%)*	20 (33%)	42 (63%)*	17 (27%)	16 (28%)	25 (40%)
Age 3	26 (48%)*	12 (18%)	15 (25%)	18 (30%)	10 (15%)	19 (31%)*	18 (32%)	16 (25%)
Age 4	6 (11%)	20 (29%)*	11 (19%)	12 (20%)	5 (7%)	14 (23%)	13 (23%)*	11 (17%)
BLACK CRAPPIE								
Age 1	1 (3%)	5 (11%)*	0 (0%)	2 (5%)	0 (0%)	3 (5%)	1 (3%)	1 (2%)
Age 2	0 (0%)	8 (17%)	24 (59%)*	11 (27%)	16 (44%)	27 (49%)	16 (46%)	20 (48%)
Age 3	32 (89%)*	7 (15%)	4 (10%)	14 (34%)	10 (28%)	20 (36%)	14 (40%)	15 (36%)
Age 4	3 (8%)	26 (57%)*	13 (32%)	14 (34%)	10 (28%)	5 (9%)	4 (11%)	6 (14%)
WHITE CRAPPIE								
Age 1	0 (0%)	8 (24%)*	1 (3%)	3 (10%)	2 (10%)	5 (26%)	0 (0%)	2 (10%)
Age 2	1 (4%)	1 (3%)	29 (83%)*	10 (32%)	9 (43%)	4 (21%)	1 (5%)	5 (25%)
Age 3	23 (96%)*	8 (24%)	2 (6%)	11 (35%)	9 (43%)	10 (53%)	12 (57%)	10 (50%)
Age 4	0 (0%)	17 (50%)*	3 (9%)	7 (23%)	1 (5%)	0 (0%)	8 (38%)	3 (15%)
LARGEMOUTH BASS								
Age 1	0 (0%)	11 (32%)*	1 (3%)	4 (15%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Age 2	2 (14%)	5 (15%)	19 (58%)*	9 (33%)	12 (57%)*	4 (18%)	0 (0%)	5 (29%)
Age 3	10 (71%)*	5 (15%)	10 (30%)	8 (30%)	6 (29%)	17 (77%)*	5 (50%)*	9 (53%)
Age 4	2 (14%)	13 (38%)*	3 (9%)	6 (22%)	3 (14%)	1 (5%)	5 (50%)*	3 (18%)

*denotes stronger year classes.

Table 7. Mean lengths and back-calculated lengths of major game fish collected at Skinner Lake, 1978-1980 and 1984-1986.

Inches								
	1978	1979	1980	Pre-project Average	1984	1985	1986	Post-project Average
BLUEGILL								
Age 1	2.6 (1.6)	2.6 (1.6)	2.2 (1.4)	2.5 (1.5)	2.5 (1.8)	2.3 (1.7)	2.2 (1.6)	2.3 (1.7)
Age 2	4.0 (3.0)	4.3 (3.5)	4.0 (3.2)	4.1 (3.2)	4.1 (3.2)	3.5 (2.6)	3.6 (2.9)	3.7 (2.9)
Age 3	5.5 (4.6)	5.6 (5.0)	5.8 (5.2)	5.6 (4.9)	5.8 (5.3)	5.0 (4.4)	5.2 (4.5)	5.3 (4.7)
Age 4	6.5 (6.2)	6.7 (6.3)	7.0 (6.5)	6.7 (6.3)	6.3 (5.9)	6.4 (5.9)	6.3 (5.8)	6.3 (5.9)
BLACK CRAPPIE								
Age 1	4.7 (2.6)	4.1 (2.5)	-	4.4 (2.6)	-	4.6 (2.9)	4.8 (3.1)	4.7 (3.0)
Age 2	-	6.2 (4.9)	6.0 (4.8)	6.1 (4.9)	6.2 (4.9)	6.3 (4.8)	6.4 (4.8)	6.3 (4.8)
Age 3	7.0 (6.3)	7.1 (5.9)	7.2 (6.6)	7.1 (6.3)	8.2 (7.2)	8.4 (7.5)	7.6 (7.0)	8.1 (7.2)
Age 4	8.8 (8.0)	7.8 (7.5)	8.0 (7.7)	8.2 (7.7)	9.1 (8.4)	10.0 (9.3)	8.9 (8.4)	9.3 (8.7)
WHITE CRAPPIE								
Age 1	-	4.9 (2.9)	3.5 (2.2)	4.2 (2.6)	4.8 (2.6)	5.3 (3.1)	-	5.1 (2.9)
Age 2	5.0 (3.1)	7.0 (5.5)	6.5 (5.2)	6.2 (4.6)	6.4 (5.0)	6.9 (5.6)	6.7 (5.3)	6.7 (5.3)
Age 3	7.2 (6.4)	8.1 (6.9)	8.4 (7.9)	7.9 (7.1)	8.7 (7.8)	8.7 (7.8)	8.2 (7.5)	8.5 (7.7)
Age 4	-	7.9 (7.6)	8.7 (8.2)	8.3 (7.9)	10.7 (9.6)	-	8.9 (8.3)	9.8 (9.6)
LARGEMOUTH BASS								
Age 1	-	5.3 (3.8)	4.9 (4.3)	5.1 (4.1)	-	-	-	-
Age 2	6.8 (5.8)	8.7 (7.1)	6.9 (6.0)	7.5 (6.3)	8.0 (6.8)	7.1 (3.8)	-	7.6 (5.3)
Age 3	9.3 (7.9)	9.8 (8.7)	9.0 (8.2)	9.4 (8.3)	10.8 (9.9)	10.0 (7.2)	9.5 (8.3)	10.1 (8.5)
Age 4	11.1 (9.8)	11.8 (10.9)	13.2 (11.6)	12.0 (10.8)	11.9 (11.0)	15.4 (10.7)	11.5 (10.5)	12.9 (10.7)

*back-calculated lengths in parenthesis based only on scales of the current age-group.

significant ($t=4.94$). The increases in mean length of black crappies at age 3 and in back-calculated lengths at ages 3 and 4 were significant ($t \geq 2.90$). None of the differences in lengths of white crappies and large-mouth before and after the project were significant ($t \leq 1.65$).

MANAGEMENT IMPLICATIONS

Changes in the trophic status of lakes can be expected to have significant impacts on fish communities. As lakes become eutrophic, fish production increases. Loss of oxygen from deeper waters forces shifts in species composition and vertical distribution of fish. Cover, food, and spawning habitat change and affect various fish. Lake eutrophication is usually accompanied by a switch toward fish more tolerant of warm water temperatures, greater turbidity, less discriminate spawning conditions and feeding. Reverses in eutrophication, therefore, can also be expected to impact fish communities.

At Skinner Lake, the watershed management practices and associated improvement in its trophic state had little impact on the overall fish community. The lake continues to be dominated by intermediate-size bluegills, abundant crappies, and a large white sucker population. However, the watershed project may have contributed to the 70% decrease in the average white crappie gill net catch rate, the increase in growth of older black crappies, and the increases in percentages of larger crappies. Since the watershed project, strong year classes of crappies have not developed.

Crappies may be good indicators of the degree of trophic conditions within northeast Indiana eutrophic lakes. They are tolerant of warm water temperatures and a wide range of turbidity. Black crappies dominate in less turbid lakes with abundant vegetation, while white crappies become abundant in lakes where turbidity limits plant growth. Black crappies are

found in virtually all northeast Indiana natural lakes. However, numbers and sizes of crappies vary. Clear, deep, top-of-the-watershed, less eutrophic lakes have fewer black crappies, but they are usually larger and grow faster. White crappies are more abundant in shallower lakes which have large watersheds, are more turbid, and more eutrophic, although mean depth is the only statistically significant factor related to crappie numbers (Pearson 1984). White crappies are present in fewer than 25% of the lakes in the area. Where white crappies are found, they are almost always associated with abundant black crappie populations. Apparently as eutrophication progresses, conditions become more favorable for development of dense black crappie populations and the appearance of white crappies.

The presence of white crappies and abundant black crappies in Skinner Lake prior to the watershed management program was most likely a direct cause of the lake's eutrophic and turbid condition. The magnitudes of the reduction in white crappie abundance and increases in crappie size are measures of the project's success. Over many years, a reduction in crappie abundance at Skinner Lake may stimulate additional changes in the fish community, such as faster crappie growth, less food competition and faster growth among other game fish.

There are at least two reasons why the watershed project did not have a greater impact on the fish community. The project involved less than 1/3 of the total acreage in the Skinner Lake watershed and the most successful practice, minimum tillage, affected less than 1/6 of the cropland acreage. The Rimmel sediment basin was judged too small to remove a high percentage of suspended clay, even during low flow. Although total phosphorus loading to the lake was reduced, the total amount of particulate matter entering the lake was not. Furthermore, estimates of the impacts of the project were based only on two years (1979 vs 1982). Longer monitoring may have

shown overall impacts on water quality in the lake were minimal.

The second reason why the project failed to stimulate major changes in the fish community (e.g. increase in bluegill size, decrease in sucker numbers) is due to the stability of diverse fish populations in Indiana natural lakes. Except for white crappies, the species composition, relative abundance, sizes, and growth of fish in Skinner Lake are not uniquely different from many lakes in the area. Similar and persistent fish communities have developed under the normal range of environmental conditions present in eutrophic natural lakes. Failure of two partial fish eradication projects in the 1960s is evidence of Skinner Lakes community stability (Pearson 1978). Only extreme alterations of local environmental conditions may impact various species in stable fish communities.

On-going soil and water conservation programs over time will reduce the rate of eutrophication of Indiana natural lakes and should be supported. However, for watershed management practices to have greater impacts on fish communities, a more coordinated effort among governmental agencies, farmers, lake residents, and fishermen is needed to focus on critical areas where dollars spent will generate the most good. Watershed projects, like the Skinner Lake project, are useful in documenting impacts of various practices on water quality and fishing, provide insight into factors which affect fish communities, and generate information on which to base future lake restoration projects.

Submitted by: Jed Pearson, Fisheries Biologist

Date: 1/15/87

Approved by:

Gary Hudson
Gary Hudson, Fisheries Supervisor

William D. James
William D. James, Chief of Fisheries

Date: 1/21/87

REFERENCES

- McNabb, C.D., B.J. Premo, J.R. Craig and M. Siami. 1982. A cooperative project to determine the effectiveness of land treatment in reducing the trophic state of Skinner Lake, Indiana. Department of Fisheries and Wildlife, Michigan State University. IN NCSWCD, 1982. 23pp.
- Noble County Soil and Water Conservation District, 1982. Impact of land treatment on the restoration of Skinner Lake, Noble County, Indiana. Albion, Indiana. 28pp.
- Pearson, J. 1978. Fish management at Skinner Lake. Indiana Department of Natural Resources, Indianapolis, Indiana. 12pp.
- Pearson, J. 1984. Distribution and abundance of crappies in Noble County lakes. Indiana Dept. of Natural Resources, Indianapolis, Indiana. 19pp.

SAMPLING EFFORT

ELECTROFISHING	Day hours	Night hours 1 hr. A.C.	Total hours 1.0
TRAPS	Number of traps 4	Hours 48	Total hours 192
GILL NETS	Number of nets 3	Hours 48	Total hours 144

PHYSICAL AND CHEMICAL CHARACTERISTICS

Color Blue-green	Turbidity 4 Feet 0 Inches (SECCHI DISK)
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Air: 62°F

TEMPERATURE Rain, wind

DEPTH FEET	DEGREES F°	DEPTH FEET	DEGREES F°	DEPTH FEET	DEGREES F°
SURFACE	69.0	40		80	
2	71.0	42		82	
4	72.0	44		84	
6	72.0	46		86	
8	72.5	48		88	
10*	71.0	50		90	
12	68.0	52		92	
14	65.0	54		94	
16*	61.0	56		96	
18	59.0	58		98	
20	57.5	60		100	
22	56.5	62			
24	56.0	64			
26	56.0	66			
28	55.0	68			
30	55.0	70			
32	54.5	72			
34		74			
36		76			
38		78			

DISSOLVED OXYGEN (D.O.) - TOTAL ALKALINITY - pH

DEPTH FEET	D.O. (ppm)*	ALKALINITY (ppm)*	pH	DEPTH FEET	D.O. (ppm)*	ALKALINITY (ppm)*	pH	Comments:
SURFACE	9.0	188	9.5	45				
5	5.0			50				
10	5.0			55				
15	1.5			60				
20	0.6			65				
25	trace			70				
30	trace	222	8.0	75				
35				80				
40								

* ppm = parts per million

COMMON SPECIES OF AQUATIC PLANTS

COMMON NAME OF PLANT	SCIENTIFIC NAME OF PLANT	DEPTH FOUND	PERCENT OF LAKE COVERED
Emergents:			
Arrow arum	Peltandra virginica	to 2 feet	rare
Pickereelweed	Pontederia spp.	to 2 feet	rare
Spatterdock	Nuphar advena	to 6 feet	common
Water lily	Nymphaea	to 4 feet	rare
Submergents:			
American pondweed	Potamogeton nodosus	to 8 feet	rare
Coontail	Ceratophyllum demersum	to 12 feet	abundant
Milfoil	Myriophyllum spp.	to 12 feet	abundant
Algae:			
Filamentous		surface	abundant
Floating:			
Duckweed	Lemna spp.	surface	rare

Comments

SPECIES AND RELATIVE ABUNDANCE OF FISHES COLLECTED BY NUMBER AND WEIGHT

*COMMON NAME OF FISH	NUMBER	PERCENT	LENGTH RANGE (Inches)	WEIGHT (Pounds)	PERCENT
Bluegill	337	49.3	1.8 - 7.3	22.77	12.5
Black crappie	78	11.4	4.8 - 14.0	14.98	8.2
White sucker	67	9.8	5.3 - 16.5	56.75	31.2
Yellow perch	45	6.6	4.3 - 7.4	4.67	2.6
White crappie	34	5.0	6.7 - 12.4	10.12	5.6
Pumpkinseed sunfish	29	4.2	2.3 - 5.3	1.56	0.9
Largemouth bass	18	2.6	1.5 - 13.5	10.68	5.9
Brown bullhead	17	2.5	7.2 - 12.3	9.58	5.3
Warmouth	14	2.0	2.8 - 5.8	.64	0.4
Golden shiner	11	1.6	6.4 - 8.6	2.08	1.1
Spotted gar	10	1.5	13.9 - 29.0	19.01	10.4
Lake chubsucker	5	0.7	3.1 - 10.1	1.12	0.6
Carp	4	0.6	20.0 - 22.0	19.30	10.6
Bowfin	3	0.4	13.9 - 20.9	5.54	3.0
Yellow bullhead	3	0.4	8.9 - 10.9	1.65	0.9
Brook silverside	3	0.4	3.8 - 4.0	.03	-
Spotted sucker	2	0.3	8.4 - 8.6	.51	0.3
Golden redhorse	1	0.1	15.0	1.10	0.6
Green sunfish	1	0.1	3.7	.03	-
Grass pickerel	1	0.1	2.4	.01	-
	683			182.13	

*Common names of fishes recognized by the American Fisheries Society

NUMBER, PERCENTAGE, WEIGHT, AND AGE OF: (species) BLUEGILL

TOTAL LENGTH (Inches)	NUMBER COLLECTED	PERCENT OF FISH COLLECTED	AVERAGE WEIGHT (Pounds)	AGE OF FISH	TOTAL LENGTH (Inches)	NUMBER COLLECTED	PERCENT OF FISH COLLECTED	AVERAGE WEIGHT (Pounds)	AGE OF FISH
1.0					14.5				
1.5					15.0				
2.0	14	4.2	.01	I+	15.5				
2.5	12	3.6	.02	I+	16.0				
3.0	24	7.1	.02	II+	16.5				
3.5	52	15.4	.03	II+	17.0				
4.0	53	15.7	.04	II+	17.5				
4.5	25	7.4	.05	II+, III+	18.0				
5.0	53	15.7	.08	III+	18.5				
5.5	43	12.8	.10	III+, IV+	19.0				
6.0	26	7.7	.13	III+, IV+	19.5				
6.5	29	8.6	.16	IV+	20.0				
7.0	5	1.5	.17	IV+, VI+	Total	337			
7.5	1	0.3	.23	V+, VI+					
8.0									
8.5									
9.0									
9.5									
10.0									
10.5									
11.0									
11.5									
12.0									
12.5									
13.0									
13.5									
14.0									

ELECTROFISHING CATCH	228	GILL NET CATCH	46	TRAP NET CATCH	63
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NUMBER, PERCENTAGE, WEIGHT, AND AGE OF: (species)

BLACK CRAPPIE

TOTAL LENGTH (Inches)	NUMBER COLLECTED	PERCENT OF FISH COLLECTED	AVERAGE WEIGHT (Pounds)	AGE OF FISH	TOTAL LENGTH (Inches)	NUMBER COLLECTED	PERCENT OF FISH COLLECTED	AVERAGE WEIGHT (Pounds)	AGE OF FISH
1.0					14.5				
1.5					15.0				
2.0					15.5				
2.5					16.0				
3.0					16.5				
3.5					17.0				
4.0					17.5				
4.5					18.0				
5.0	1	1.3	.04	I+	18.5				
5.5	2	2.6	.08	II+	19.0				
6.0	13	16.7	.10	II+	19.5				
6.5	23	29.5	.13	II+	20.0				
7.0	16	20.5	.16	II+, III+	TOTAL	78			
7.5	5	6.4	.19	II+, III+					
8.0	5	6.4	.25	III+					
8.5	3	3.8	.26	III+, IV+, V+					
9.0	5	6.4	.33	IV+, V+, VI+					
9.5	3	3.8	.40	IV+, V+					
10.0	1	1.3	.39	V+					
10.5									
11.0									
11.5									
12.0									
12.5									
13.0									
13.5									
14.0	1	1.3	1.65	VII+					

ELECTROFISHING CATCH

3

GILL NET CATCH

67

TRAP NET CATCH

8

NUMBER, PERCENTAGE, WEIGHT, AND AGE OF: (species) WHITE CRAPPIE

TOTAL LENGTH (Inches)	NUMBER COLLECTED	PERCENT OF FISH COLLECTED	AVERAGE WEIGHT (Pounds)	AGE OF FISH	TOTAL LENGTH (Inches)	NUMBER COLLECTED	PERCENT OF FISH COLLECTED	AVERAGE WEIGHT (Pounds)	AGE OF FISH
1.0					14.5				
1.5					15.0				
2.0					15.5				
2.5					16.0				
3.0					16.5				
3.5					17.0				
4.0					17.5				
4.5					18.0				
5.0					18.5				
5.5					19.0				
6.0					19.5				
6.5	1	2.9	.13	II+	20.0				
7.0	1	2.9	.16	III+	TOTAL	34			
7.5	1	2.9	.17	III+					
8.0	4	11.8	.23	III+					
8.5	8	23.5	.26	III+, IV+					
9.0	15	44.1	.30	III+, IV+					
9.5	1	2.9	.33	V+					
10.0	1	2.9	.36	V+					
10.5									
11.0									
11.5									
12.0	1	2.9	.75	VI+					
12.5	1	2.9	.75	VI+					
13.0									
13.5									
14.0									

ELECTROFISHING CATCH

3

GILL NET CATCH

15

TRAP NET CATCH

16

NUMBER, PERCENTAGE, WEIGHT, AND AGE OF: (species) LARGEMOUTH BASS

TOTAL LENGTH (Inches)	NUMBER COLLECTED	PERCENT OF FISH COLLECTED	AVERAGE WEIGHT (Pounds)	AGE OF FISH	TOTAL LENGTH (Inches)	NUMBER COLLECTED	PERCENT OF FISH COLLECTED	AVERAGE WEIGHT (Pounds)	AGE OF FISH
1.0					14.5				
1.5	1	5.6	.01	0+	15.0				
2.0	1	5.6	.02	0+	15.5				
2.5					16.0				
3.0					16.5				
3.5					17.0				
4.0					17.5				
4.5					18.0				
5.0					18.5				
5.5					19.0				
6.0					19.5				
6.5					20.0				
7.0					Total	18			
7.5									
8.0									
8.5									
9.0	1	5.6	.31	III+					
9.5	3	16.7	.36	III+					
10.0									
10.5	2	11.1	.55	IV+					
11.0	1	5.6	.56	IV+					
11.5	2	11.1	.68	IV+					
12.0	4	22.2	.81	IV+,V+					
12.5	1	5.6	.84	IV+					
13.0	1	5.6	1.01	-					
13.5	1	5.6	1.16	V+					
14.0									

ELECTROFISHING CATCH	15	GILL NET CATCH	1	TRAP NET CATCH	2
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29

Species: BLUEGILL		YEAR CLASS	NUMBER OF FISH AGED	BACK CALCULATED LENGTH (Inches) AT EACH AGE					
				I	II	III	IV	V	VI
0.8" intercept		1985	10	1.6					
		1984	16	1.7	2.9				
		1983	18	1.7	3.0	4.5			
		1982	13	1.6	2.9	4.4	5.8		
		1981	1	1.5	2.7	4.8	6.9	7.1	
		1980	2	1.7	3.1	4.1	5.7	6.3	6.7
		AVERAGE LENGTH		1.6	2.9	4.5	6.1	6.7	6.7
		NUMBER AGED		60	50	34	16	3	2

Species:		YEAR CLASS	NUMBER OF FISH AGED	BACK CALCULATED LENGTH (Inches) AT EACH AGE					
BLACK CRAPPIE				I	II	III	IV	V	VI
0.8" intercept		1985	1	3.1					
		1984	16	2.0	4.8				
		1983	14	2.0	4.4	7.0			
		1982	4	2.3	5.2	7.5	8.4		
		1981	6	2.2	5.1	6.7	8.0	8.8	
		1980	1	1.9	3.3	5.0	7.8	8.7	9.0
		AVERAGE LENGTH			2.3	4.6	6.6	8.1	8.8
NUMBER AGED			42	41	25	11	7	1	

Species:		YEAR CLASS	NUMBER OF FISH AGED	BACK CALCULATED LENGTH (Inches) AT EACH AGE					
White crappie				I	II	III	IV	V	VI
0.8" intercept		1985	0						
		1984	1	1.8	5.3				
		1983	12	1.9	4.9	7.5			
		1982	8	2.4	5.3	7.5	8.3		
		1981	2	2.5	4.9	6.3	8.0	8.8	
AVERAGE LENGTH			2.2	5.1	7.1	8.2	8.8		
NUMBER AGED			23	23	22	10	2		

Species:		YEAR CLASS	NUMBER OF FISH AGED	BACK CALCULATED LENGTH (Inches) AT EACH AGE					
				I	II	III	IV	V	VI
LARGEMOUTH BASS 0.8" intercept		1985	0						
		1984	0						
		1983	5	3.5	6.2	8.3			
		1982	5	4.9	7.8	9.3	10.5		
		1981	3	3.8	7.0	9.4	10.9	12.1	
		AVERAGE LENGTH		4.1	7.0	9.0	10.7	12.1	
		NUMBER AGED		13	13	13	8	3	

NOTE: If not included in average length calculations indicate with a (*)